Article 11

automobile

Britannica Elementary Encyclopedia

automobile

The term automobile can refer to any type of self-propelling vehicle, including trucks, vans, and tractors. The word is most commonly used, however, to refer to passenger vehicles that seat two to six people, generally known as cars. Automobile means "self-moving," but an automobile does require a power source and a person to start and steer it. Most automobiles run on gasoline, which is made from petroleum (oil).

About half a billion passenger cars run on the world's roads, about a third of them in the United States. Since the car came into widespread use early in the 20th century, it has probably changed society more than any invention in modern times other than the computer. It has made people much more mobile and given them a freedom to travel that was unavailable to previous generations. It has created a need for roads, which have greatly changed the appearance of towns and cities and the countryside in much of the world. It has also influenced where people live. People once had to live near their jobs, but now they can live farther away and drive to work.

Yet along with the benefits, automobiles have brought problems as well. Tens of thousands of people are killed or injured each year in traffic accidents. Cities are often congested with huge traffic jams. And gasoline is a limited resource that pollutes the atmosphere when burned as fuel.

Parts of an automobile

Automobiles come in many shapes and sizes: two-door sports cars, family sedans, vans, sport-utility vehicles (SUVs), and more. All automobiles have certain basic parts, though those parts often vary based on the type of vehicle.

Body

The body of an automobile is the outer shell that encloses the vehicle's mechanical parts and its passengers. Most auto bodies are made of steel. This metal is used because of its general availability, low cost, and good workability. Some auto bodies are made of strong plastics or fiberglass.

A vehicle's body type depends on its size and uses. A coupe is generally a two-door car with a small back seat. Sedans come in two-door and four-door versions and generally seat four to six people. Sedans with a lift-up rear door are called hatchbacks. Sports cars are low to the ground, usually with sleek, two-door designs. Convertibles have tops that fold down for driving in nice weather. Station wagons are longer vehicles that accommodate families and more storage space. By the late 20th century station wagons had given way to taller vans and SUVs. Recreational vehicles (RVs) are long vehicles with sleeping quarters, kitchens, and bathrooms.

Designers try to make the main passenger compartment into a safety box that remains rigid in a crash. The front and rear ends of the car are usually designed to crumple in a collision without affecting the box. Manufacturers carry out crash tests on their cars to see how well the designs behave in practice. Features such as shatterproof windows, padded dashboards, seat belts, and air bags contribute to passenger safety.

Engine and related systems

Most automobiles are powered by an internal-combustion engine. This type of engine collects power from the expansion of gases to propel the vehicle. A fuel, usually gasoline, is burned with air to create the expanding gas. This energy is processed with the help of parts called pistons or a rotor and converted into a rotating force, called torque. The automobile's transmission harnesses the torque and transfers the power to the wheels.

In most automobile engines, the combustion chamber consists of cylinders in which closely fitted pieces called pistons slide up and down. A mixture of air and gas is periodically allowed to enter the cylinder. A spark plug creates a spark that ignites the gas, causing the gas to expand. The force created by the expanding gas is used to move the pistons within the cylinders. The piston is attached to a connecting rod, which in turn is coupled to a device called a crankshaft. Through the connecting rod the action of the crankshaft converts the up-and-down motion of the piston into rotary motion. A number of cylinders can be used, each with a piston connected to the crankshaft. Four to six cylinders are normal for automobile engines, though cars with as many as 16 cylinders have been built.

The diesel engine is the most fuel-efficient form of internal-combustion engine. Diesel engines are piston-cylinder devices. They compress air to high pressures before injecting small droplets of fuel into the combustion chamber. High temperatures cause the fuel to burn without a spark, which a gasoline engine requires. However, the need to create high pressures means that the engine must be heavy. Diesel engines are therefore most useful on trucks, buses, and other large vehicles.

Some automobiles have internal-combustion engines that operate without pistons. These engines use the force of expanding gas to rotate a device called a turbine. Some of the heat given off by the gas is in turn reused by the engine. Gas turbine engines have been used in trucks and military vehicles. The Wankel rotating engine centers on a part called a rotor, which has the shape of a triangle. The turning of the rotor draws in fuel and air, ignites it, and expels it. Rotating engines are generally smaller and lighter than piston engines.

Fuel system

An automobile's fuel system consists of a fuel tank, fuel pump, one or more carburetors, and fuel lines. The fuel tank is the place where the fuel is stored. In the carburetor, fuel is mixed with air before being supplied to the engine via the fuel pump. Some engines, including all diesel engines, have a fuel-injection system rather than a carburetor. This system forces fuel into the engine's combustion chamber in carefully measured amounts. The air-fuel mixture enters the engine through the opening and closing of valves. These valves are controlled by the camshaft, which turns the engine.

Electrical system

The air-fuel mixture that enters the engine cannot ignite by itself. It needs an electric spark. Electric current is supplied by a storage battery, which is automatically recharged by an engine-driven generator (or alternator) while the car is running. Wires from the battery take current to the ignition coil. This coil creates the high voltage (electrical pressure) needed to create the spark that ignites the air-fuel mixture in the cylinders. The spark itself is created by devices called spark plugs. The automobile's lights, horn, indicators, windshield wipers, starter, and instruments such as the gasoline gauge also are powered by the storage battery. The starter is an electric motor that cranks, or turns, the engine until the spark plugs ignite the air-fuel mixture.

Exhaust system

The exhaust system consists of the manifold, muffler, exhaust pipe, and tailpipe. The manifold carries burned gases from the engine to the muffler, which reduces the pressure of the gases. The muffler also keeps the car running quietly by discharging the gases through the tailpipe. Since the mid-1970s most cars have also been equipped with a catalytic converter. This device, placed along the tailpipe, is coated with chemicals that convert exhaust gases into carbon dioxide and water, thus reducing pollution.

Cooling system

The burning of fuel inside the engine produces a lot of heat. Some of the heat is carried away in the engine exhaust, but most has to be removed by the cooling system. Most cars have a liquid cooling system. Water circulates through passages around the cylinders and takes in heat. The hot water then flows through the tubes of a radiator, which are cooled by air flowing over them. A fan driven by the engine draws air through the radiator. A water pump, often mounted with the fan, pumps the cool water from the radiator back to the engine. Some engines depend on a flow of air over the engine and have no liquid coolant.

Lubrication system

The lubrication system supplies the engine's moving parts with oil so that they move smoothly. The oil is held in a reservoir beneath the engine. A pump delivers it through passages to bearings that support the crankshaft and other rods and shafts. Lubrication prevents engine parts from rubbing against each other, which can cause damage.

Power train

The engine powers an automobile, but it does not turn the wheels. The parts of the car that transmit, or deliver, power from the engine to the wheels are together called the power train. The power train consists of the transmission, clutch, drive shaft, and differential. Most car engines originally transmitted power only to the rear wheels. Today, however, many cars send power to the front wheels (front-wheel drive) or to all the wheels (four-wheel drive). Front-wheel and four-wheel drive improve traction—the car's ability to grip the road—because the engine's weight is centered over the wheels that power the car.

Transmission and clutch

The transmission is a device that controls the speed and power output of the engine. Different amounts of torque (rotating power) are needed to move a car under different conditions. When a car is traveling at moderate speed on a level road, the engine does not need to supply much

torque to keep it going. When the car is starting from a dead stop or moving up a hill, however, the engine must deliver more torque to get or keep the car moving. Through the use of gears, the transmission reduces or increases the speed and power of the engine to adjust to different driving situations.

A transmission may be either manual or automatic. Cars with a manual transmission require the driver to change gears by using a gearshift lever and a clutch. The clutch is usually controlled with a foot pedal. It disconnects the engine from the wheels so that the driver can change gears with the gearshift lever. In cars with an automatic transmission, gears change without the need for manual control of the gearshift and clutch.

Drive shaft

The drive shaft carries the torque from the transmission to the axle, which connects the wheels. This shaft requires several universal joints. These allow for flexibility in the axle and wheels as the car drives over uneven roads.

Differential

The differential is connected to the rear end of the drive shaft. It divides power between the wheels while they turn at different speeds on curves. The different speeds are necessary because the outer wheels must travel farther and faster than the inner wheels when the car turns.

Chassis

The chassis is the main structure of the modern automobile. In most designs a steel frame forms a skeleton on which the engine, transmission, steering system, brakes, suspension system, axles, and tires are mounted. The frame must be stiff and strong enough to resist severe twisting and bending. Large cars have separate bodies and frames, but compact cars are usually built with the frame and body combined.

Steering system

The steering wheel held by the driver is connected by gears and rods to arms attached to the axle assemblies that carry the front wheels. These assemblies are pivoted so that turning the steering wheel makes the front wheels point left or right. Nearly all modern cars have a rack-and-pinion system in which a gearwheel (pinion), attached to the bottom of the steering column, engages a toothed bar (rack) that moves as the column turns. Rack-and-pinion steering improves control but is not suitable for larger cars because it requires too much strength. The introduction of power steering in the 1930s made steering much easier. This usually works hydraulically, by means of pressure from an engine-driven pump.

Brakes

The brakes are a vital part of the chassis. A vehicle's main braking system is a hydraulic system controlled by a foot pedal. When the brake pedal is pressed, pistons force fluid through small, flexible pipes to braking mechanisms in each wheel. This stops the vehicle. Automobiles also come with a hand-operated emergency brake, which can be used if the hydraulic system fails. It is also called the parking brake because it is often used to prevent a vehicle from rolling while parked. Many modern cars have an antilock braking system, which keeps the tires from

locking up when the vehicle skids on an slippery road. Because the wheels continue to roll, the driver is still able to steer the vehicle while the brakes slow it down.

Suspension system and tires

The suspension system absorbs up-and-down motion as a vehicle travels over uneven roads. This is done by fitting springs between the axles of the wheels and the car body. Independent suspension systems allow each wheel to move up and down on its own, providing greater flexibility. Shock absorbers cushion the movement of the springs to further reduce the amount of bounce.

An automobile's tires also help absorb the impact of the road. The rubber and the compressed air inside make them into a kind of spring. But their main purpose is to provide grip to keep the car firmly on the road in all conditions. The tread—the part of the tire that touches the road—varies based on the characteristics of the surface on which the vehicle is intended to operate. Deep tread designs provide grip in loose soil and snow. Smooth surfaces are used for purposes such as racing.

History

The artistic and scientific genius Leonardo da Vinci came up with the idea for a self-propelled vehicle as far back as the 15th century. The first true automobile, however, is considered to be a three-wheeled, steam-powered vehicle built by Nicolas-Joseph Cugnot of France in 1769. Designed to haul artillery, it was a huge, heavy carriage that moved very slowly. Cugnot's achievement was followed by a number of other steam-powered vehicles in the late 18th and early 19th centuries. William Murdoch, Richard Trevithick, and others built steam-powered wagons and carriages in England. Oliver Evans built the first steam-powered motor vehicle in the United States in 1805. A flat-bottomed boat with wheels, it ran on both water and land.

Steam and electric automobiles

Some 100 manufacturers produced steam-driven automobiles during the late 1890s and early 1900s. In the United States, the twin brothers Francis E. and Freelan O. Stanley became famous with their Stanley Steamer. This and other steam cars burned kerosene, which heated water and created steam to power the driving mechanism. But the steam car had some drawbacks. One of them was that the water in the vehicle's water tank, or "boiler," took too long to heat up.

Inventors also experimented with electric-powered automobiles around this time. Several models were built in Europe during the 1880s. William Morrison produced one of the first "electrics" in the United States in 1891. More than 50 U.S. manufacturers turned out almost 35,000 electric cars between 1896 and 1915—the period of their greatest popularity. The electric car ran smoothly and was easy to operate. However, it did not run efficiently at speeds of more than 20 miles per hour (32 kilometers per hour) and could not travel more than 50 miles (80 kilometers) without having its batteries recharged. For this reason it was limited to city use.

Early gasoline automobiles

Gasoline eventually prevailed over steam and electricity as a source of power in automobiles. Gas engines allowed vehicles to travel at higher speeds and for longer distances than steam-

or electric-powered engines. They were also safer and less troublesome than steam-powered engines.

Gasoline-powered vehicles were first created in Europe. Étienne Lenoir of France developed a gasoline engine in 1860, and two years later he built a vehicle powered by that engine. In 1876 the German Nikolaus Otto built a gas-powered internal-combustion engine. It was the first practical alternative to the steam engine as a power source. The Germans Gottlieb Daimler and Karl Benz began building gasoline-based cars separately in the 1880s. Yet another German, Rudolf Diesel, received a patent for the engine that bears his name in 1892.

Birth of the automobile industry

Automobile production began in the United States in the 1890s. The brothers Charles E. and J. Frank Duryea created the first gasoline-powered car in the country in 1893. Three years later they began producing their car for sale. Ransom E. Olds, creator of the Oldsmobile, introduced mass production to the automobile industry in 1901. His company manufactured 400 automobiles in that year and sold them for just 650 dollars apiece. Olds's sales reached 5,000 in 1904.

Henry Ford created his first automobile in Detroit in 1896. The Ford Motor Company was established in 1903. Although Olds is credited with beginning mass production, Ford first introduced the process on a large scale with his creation of the assembly line in 1913. In this method of production, individual workers focus on a single task in the creation of cars as the parts pass by on a conveyer. This process greatly increased automobile production and soon spread to other industries. Between 1908 and 1927 Ford sold more than 15 million of his trademark automobile, the Model T. This car spurred interest in driving and the building of roads in the United States.

Along with the Ford Motor Company, a number of other famous automobile makers were established in the early 20th century. In the United States, William C. Durant founded the General Motors Corporation in 1908, Louis Chevrolet started the Chevrolet Motor Company in 1911, John and Horace Dodge organized the Dodge Motor Company in 1914, and Walter P. Chrysler began the Chrysler Corporation in 1925. In Germany, Gottlieb Daimler and Karl Benz combined their companies in 1926 to form the Daimler-Benz Corporation. (Decades later, in 1998, Daimler-Benz merged with the Chrysler Corporation to form DaimlerChrysler AG.)

Automotive innovations

During World War I (1914–18) the United States halted most manufacturing of automobiles for civilians. The industry instead focused on creating vehicles, motors, and other products for military use. After the war commercial production began again, and the automobile soon moved from a position of luxury to one of necessity for many people. By the late 1920s the car was commonplace in the United States and other industrial nations.

Manufacturers began to add new features to make their automobiles safer, more comfortable, and more stylish. Four-wheel brakes were used in production models in 1920. Steel bodies, hydraulic brakes, and hot-water heaters became common. Henry Ford introduced the conventional gearshift with his Model A in the mid-1920s. Automatic transmissions became available in 1937.

After supporting the war effort during World War II (1939–45), the automobile industry introduced more innovations. Automakers began using power steering, power brakes, wraparound windshields, and automatic controls for windows and seats. They also continued to make engines more powerful.

In the 1950s European and Japanese automakers introduced compact cars to the United States. These cars required less fuel than the large cars popular in the United States at the time. Some U.S. automakers also experimented with compact cars, but they were not successful until the oil crisis of the 1970s.

The modern industry

In 1973 oil-producing Arab nations began raising prices and stopping oil shipments, partly as a response to U.S. support for Israel. Oil prices shot up in the United States and other Western nations, and oil shortages caused huge lines at gas stations (*see* Organization of Petroleum Exporting Countries). The U.S. government responded by urging its citizens to conserve, and automakers increased their production of compact, fuel-efficient automobiles. Some U.S. manufacturers produced models that lost as much as 1,000 pounds (450 kilograms) of weight and 1 foot (30 centimeters) in length from one year to the next. Oil prices fell during the 1980s.

Meanwhile, Japan and Europe had begun to compete effectively with U.S. automakers. By 1980 Japan had surpassed the United States in automobile production. Today automobile production is a complex international business. The world's largest automakers own or control production facilities in more than one country.

In the last decades of the 20th century governments and the automobile industry were forced to deal with problems related to the widespread use of automobiles. One was the great loss of life in automobile accidents. Each year hundreds of thousands of people are killed in accidents worldwide, including more than 40,000 in the United States alone. Efforts to improve highway safety included making seat belts and air bags standard features in automobiles. In the United States, most states require drivers and passengers to wear seat belts, and all states require special restraint seats for children. The desire to reduce fatalities also led to the establishment of speed limits in many countries.

A great increase in air pollution was another negative of automobile use. Government regulations reduced automotive air pollution by forcing the adoption of lead-free gasoline and catalytic converters. Newer engines that burn fuel more efficiently also cut down on pollution. Even after such treatment, however, automobile exhaust still contains gases that contribute to such problems as global warming. Concerns about the environmental impact of automobile use grew in the 1990s with the popularity of SUVs, which burn much more gas than smaller vehicles. By the 21st century some automakers were experimenting with hybrid vehicles, which combined gasoline and electric power.

To cite this page:

- MLA style:
  " **automobile** ." Britannica Elementary Encyclopedia. 2007. Encyclopædia Britannica Online School Edition. 14 2007 <http://school.eb.com/ebk/article?articleId=352807>.
- APA style:
  automobile . (2007). In *Britannica Elementary Encyclopedia*. Retrieved 14, 2007, from

Encyclopædia Britannica Online School Edition: http://school.eb.com/ebk/article?articleId=352807